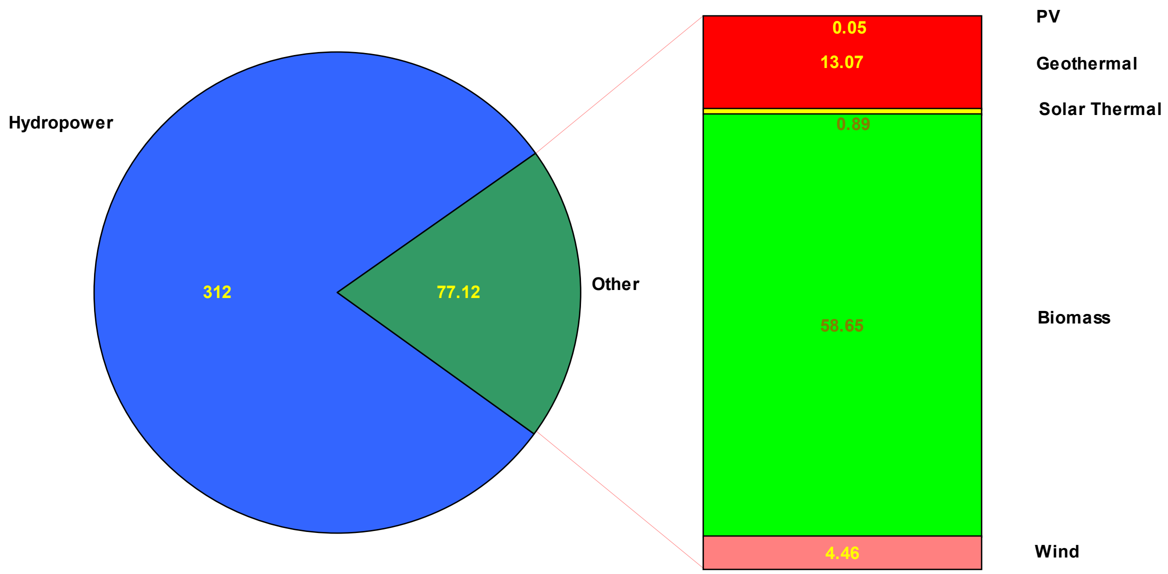
1. SITUATION ANALYSIS

Biopower (biomass-to-electricity power generation) is a proven electricity generating option in the United States, and with about 11 GW of installed capacity, is the single largest source of non-hydro renewable electricity, as shown in Figure 1.1. This 11 GW of capacity encompasses about 7.5 GW of forest product and agricultural industry residues, about 3.0 GW of MSW-based generating capacity, and 0.5 GW of other capacity such as landfill gas based production. The electricity production from biomass is being used and is expected to continue to be used as base load power in the existing electrical distribution system.

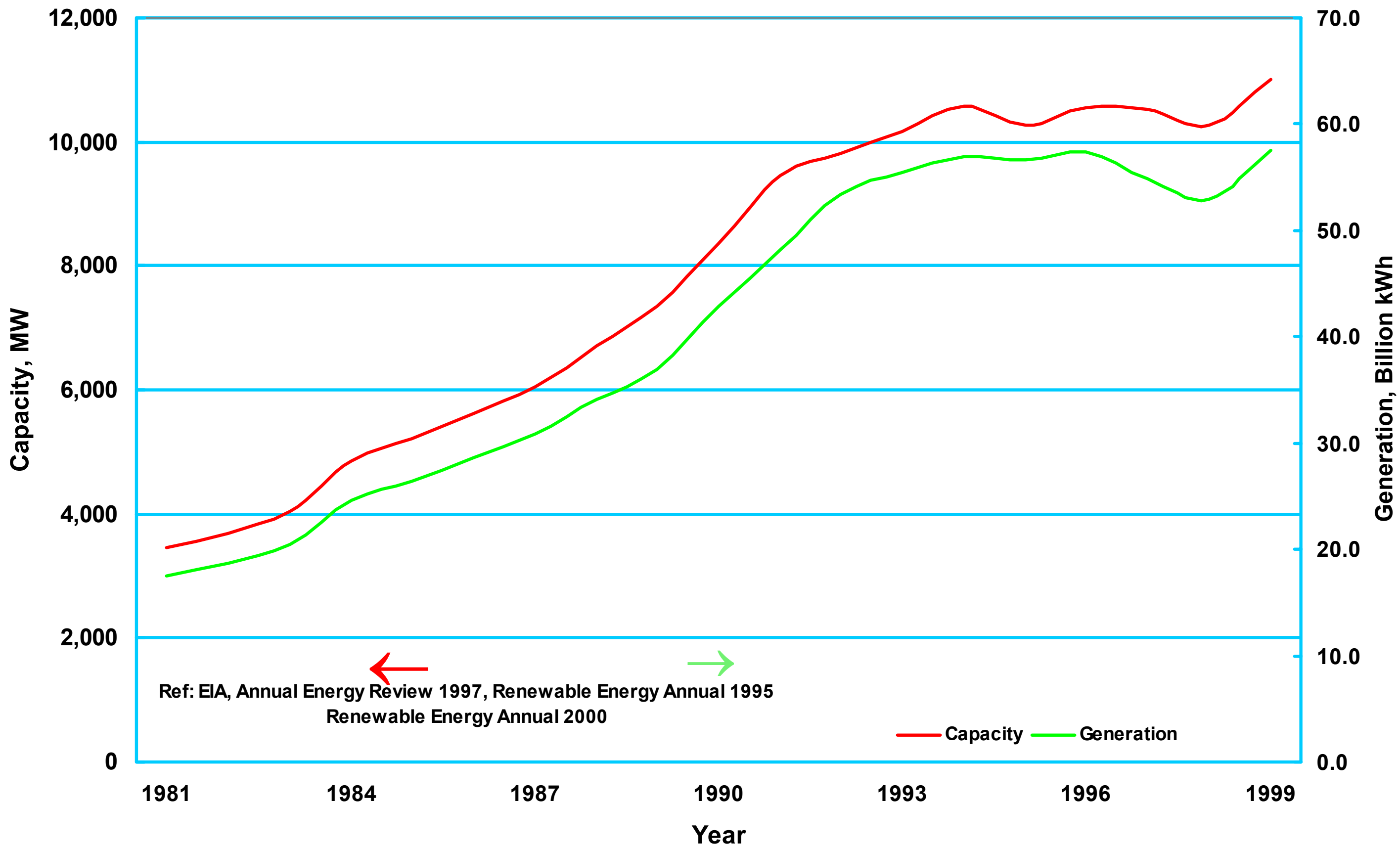
Figure 1.1: 1999 Renewable Electricity Generation
(Billion Kilowatthours)



Source: DOE EIA Annual Energy Outlook 2001

In the United States, biopower experienced dramatic growth after the Public Utilities Regulatory Policy Act (PURPA) of 1978 guaranteed small electricity producers (less than 80 MW) that utilities would purchase their surplus electricity at a price equal to the utilities' avoided cost of producing electricity. The passage of PURPA as well as various state incentives resulted in a factor-of-three increase in grid-connected biopower generating capacity in the period from 1980-1990 (See Figure 1.2). The certainty of these contracts propelled industry investment to $15 billion dollars and created 66,000 jobs. The PURPA legislation had no energy efficiency criterion and no incentives to add capacity at higher efficiency. In addition, the time needed to recover the investment was less than 10 years, so most investments were made on state-of-theart technology at the time (combustion/steam). As a consequence, these plants, as a whole, had fairly low efficiency (industry average of 20% with notable exception at individual plants).

Figure 1.2: Bioenergy Electricity Generation, 1981 - 1999



Since "conventional" biopower was apparently well on its way in the commercial marketplace, research during subsequent periods focused on more advanced combustion technologies and gasification.

By the early 1990s, the biopower industry was beginning to stall for many reasons including higher feedstock costs, caused by inadequate infrastructure and no explicit accounting for the environmental benefits in utility regulation or market costing, and much lower new generation costs compared to natural gas CC. In addition, avoided cost contracts signed under PURPA were expiring and the utilities were unsuccessful in petitioning to buy back the contracts. More recently, the biopower industry has experienced uncertainty surrounding impending utility restructuring in a number of states. This situation has had detrimental effects on the industry that are still being felt today.

The 7.5 GW of traditional biomass capacity represents about 1% of total electricity generating capacity and about 8 % of all non-utility generating capacity. More than 500 facilities around the country are currently using wood or wood waste to generate electricity. Fewer than 20 of these facilities are owned and operated by investor- or municipally- owned electric utilities. The majority of the capacity is operated in combined heat and power (CHP) facilities in the industrial sector, primarily in pulp and paper mills and paperboard manufacturers. Some of these facilities have buy-back agreements with local utilities to purchase net excess generation. Additionally, a moderate percentage of biomass power facilities are owned and operated by non-utility generators, such as independent power producers that have power purchase agreements with local utilities. The number of such facilities is decreasing somewhat as utilities buy back existing contracts. The stand-alone power production facilities largely use non-captive residues, including wood waste purchased from forest products industries and from urban wood waste streams, agricultural residues from harvesting and processing, used wood pallets, and some waste wood from construction and demolition, to generate electricity. In most instances, the generation of biomass power by these facilities also facilitates a reduction in local and regional waste streams.

All of today's capacity is based on mature, direct combustion boiler/steam turbine technology. The average size of existing biopower plants is 20 MW (the largest approaches 75 MW) and the average biomass- to-electricity efficiency of the industry is 20%. These small plant sizes (which lead to higher capital cost per kilowatt-hour of power produced) and low efficiencies (which increase sensitivity to fluctuation in feedstock price) have led to electricity costs in the 8-12 ¢/kWh range.

The near term domestic opportunity for gasification combined cycle technology is in the forest products industry, where a majority of whose power boilers will reach the end of their useful life in the next 10-15 years. This industry is familiar with use of its low-cost residues ("hog" fuel and a waste product called "black liquor") for generation of electric and heat for its processing needs. The higher efficiency of gasification based systems would bolster this self-generation (offsetting increasing electricity imports from the grid) and perhaps allow export of electricity to the grid. The industry is also investigating the use of black liquor gasification in combined cycles to replace the aging fleet of kraft recovery boilers.

An even nearer-term and lower-cost option for the use of biomass is cofiring with coal in existing boilers. Cofiring biomass with coal has the potential to produce 7.5 GW by 2010 and 26 GW by 2020. Though the current substitution rate is negligible, a rapid expansion is possible based on wood residues (urban wood, pallets, secondary manufacturing products) and dedicated feedstock supply systems (DFSS) such as willow, poplar and switchgrass. The carbon replacement rate in 2010 would be 14.5 Tg.

The next generation of stand-alone biopower production will substantially mitigate the high costs and efficiency disadvantages of today's industry. The industry is expected to dramatically improve process efficiency through the use of cofiring of biomass in existing coal-fired power stations, through the introduction of high-efficiency gasification combined cycle systems, and through efficiency improvements in direct combustion systems made possible by the addition of dryers and more rigorous steam cycles at larger scales of operation. Technologies presently at the research and development stage, such as Whole Tree Energy™, integrated gasification fuel cell systems, and modular systems are expected to be competitive in the future.